

EL

Notice of Allowability

Application No.

10/509,573

Examiner

Tiffany A. Fetzner

Applicant(s)

XIAO ET AL.

Art Unit

2859

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 11/8/2666 and the telephonic interview of 1/19/2006.
2. ☒ The allowed claim(s) is/are 6-9.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☒ All b) ☐ Some* c) ☐ None of the:
 1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☒ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☒ hereto or 2) ☒ to Paper No./Mail Date 01/23/2006.
 - (b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date 01/23/2006.Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date 08/01/2005
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date 01/23/2006.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.
2. Authorization for this examiner's amendment was given in a telephone interview with **Attorney Jay M. Finkelstein Reg. No. 21,082** on January 19th 2006 along with authorization to charge any necessary fees to applicant's deposit account. No fees are believed to be due at this time.
3. The application has been amended as follows:

A) Replace claim 6 of the November 8th 2005 amendment and response with the following **Examiner amended claim 6**:

Claim 6 --- A permanent magnet producing a magnetic field **configured** for magnetic resonance, comprising:

permanent magnetic material;

pole heads;

plates **configured** for eliminating vortex (i.e. eddy currents);

rings **configured** for homogenizing the magnetic field;

gradient coils; and

a yoke, wherein said yoke of the **permanent** magnet has:

an integral, substantially C-shaped and open structure **formed** with two columns, said yoke is integrally manufactured by casting, and

wherein said yoke is annealed twice. ---

B) Replace claim 7 of the November 8th 2005 amendment and response with the following **Examiner amended claim 7**:

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Claim 7 --- The permanent magnet **configured** for magnetic resonance according to **claim 6**, wherein said yoke is formed of low carbon steel material having good magnetic conductivity. ---

C) Replace claim 8 of the November 8th 2005 amendment and response with the following **Examiner amended claim 8**:

Claim 8 --- The permanent magnet **configured** for magnetic resonance according to **claim 6**, wherein said yoke is designed so as to have a streamline-shape appearance. ---

D) Replace claim 9 of the November 8th 2005 amendment and response with the following **Examiner amended claim 9**:

Claim 9 --- The permanent magnet **configured** for magnetic resonance according to **claim 7**, wherein said yoke is designed so as to have a streamline-shape appearance. ---

In the Substitute Specification of November 8th 2005:

E1) On page 1 Replace the Brief Description heading and the two subsequent paragraphs, which start on page 1 and continue onto page 2 of the **November 8th 2005** substitute specification, with the following **Examiner amended** grammatical correction paragraphs:

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Brief Description of the Prior Art

The magnetic resonance imaging apparatus is a medical apparatus developed in 1980's, and the most advanced clinical diagnosis apparatus for diagnosing pre-cancer and other diseases. The magnet is a key part of the magnetic resonance imaging apparatus, the SNR (signal-to-noise ratio) of the magnetic resonance imaging apparatus has a direct relation to the performance of the magnet, so that performance of the magnet determines the quality of the image to a certain extent. The permanent magnet has a simple structure without additional means and is convenient to maintain, can be operated safely, and the area of the stray magnetic field there around is small. Therefore, the scientific, technological and medical professionals pay more and more regard to the magnetic resonance imaging apparatus using a permanent magnet.

However, the conventional box-shape permanent magnet formed of ferrite magnetic material is low in magnetic intensity, heavy, large in volume, closed and poor in practicability. In the early stage, weight of a magnet of 3000Gs was substantially 100 tons, so that it was difficult to transport and mount the magnet. Subsequently, a new magnetic material, i.e. NdFeB, was developed, and many countries have invested a lot of work and money in research and development of the magnetic resonance permanent magnet having low field strength. Recently, there has been proposed a magnet of so-called open type, which has high magnetic energy product, good uniformity, and small volume. This type of magnet has the following advantages: a patient can lie on a half-open examining table, thus eliminating the patient's dread occurring in the conventional MRI examination, so that it is easily acceptable for children or other

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apprehensive patients. In addition, during the MRI examination, the patient is not required to lie on or lie face down on the examining table, and may be seated on the table so that they may be examined on a part of the body thereof such as the extremities. In addition, it is possible to provide interventional therapy to the patient. Therefore, this type of magnet has developed rapidly and a lot of products are available on the market. Since this type of magnet is cheap, the market share thereof has increased gradually. However, the above conventional products have a separated structure, the yoke part of the magnet is formed by a plurality of portions assembled to each other. Therefore, it is difficult to ensure parallelism of the upper yoke to the lower yoke during manufacturing and assembling, thus deteriorating the performance of the magnet to a certain extent, more particularly, decreasing the mechanical strength of the magnet and affecting the uniformity of the magnetic circuit.

E2) Replace the paragraph beginning on page 3, line 3 of the November 8th 2005 substitute specification, with the following Examiner amended grammatical corrections:

The above object is accomplished by providing a permanent magnet comprising: a yoke, magnetic materials, pole heads, plates for eliminating vortex (i.e. eddy currents), rings for homogenizing magnetic field, and gradient coils. The yoke of the present invention is integrally formed by casting, has a substantially C-shaped and open structure with two columns, the magnetic material is adhesive bonded to the yoke, the pole

heads are adhesive bonded to the yoke, plates for eliminating vortex (i.e. eddy currents) are adhesive bonded to the pole heads respectively, and the gradient coils and rings for homogenizing magnetic field are mounted to the pole heads respectively, with the gradient coils located inside and the rings for homogenizing magnetic field located outside, each of the rings for homogenizing the magnetic field is respectively formed of a plurality of arc sections fixed to the pole heads so as to form a ring.

E3) Replace the paragraph beginning on page 3, line 18 of the November 8th 2005 substitute specification, with the following Examiner amended grammatical corrections:

The magnet of the present invention is integrally formed by casting, which has a substantially C-shaped and open structure with two columns, so that it is simply in a single structure. The magnetic circuit thereof is designed by two-dimensional or three-dimensional simulation using a computer, the magnetic material is formed of consubstantial NdFeB using a series of high and new-technologies and processes, thus ensuring good uniformity and stability, small area of the stray magnetic field, and eliminating substantially vortex effect (i.e. eddy currents). The yoke part of the present invention is formed integrally of low carbon steel by casting, the material forming the yoke part is uniform, the crystal grains of the yoke part are uniform and consistent as a result of annealing the material forming the yoke part twice, thus eliminating the internal stress completely. The defects in the yoke part can be

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eliminated by magnetic particle and ultrasonic inspection, so that the parallelism of the lower yoke to the upper yoke can be ensured to the maximum extent, thus increasing mechanical strength of the yoke frame and ensuring uniformity of the magnetic field and fluency of the magnetic circuit. At the same time, the yoke frame is designed as a streamline shape and thereby meets the requirements of the design principle of the magnetic circuit of the magnet, so that the magnet is light, has low flux leakage and good appearance. The magnet of the present invention employs NdFeB as the magnetic material having high performance, thus increasing uniformity of the magnet and eliminating the vortex (i.e. eddy current) effect generally occurring in conventional permanent magnets. The base magnetic field is good, so that the magnetic field can be homogenized easily.

E4) Replace the "reference numeral" paragraph (i.e. the third paragraph under the BRIEF DESCRIPTION OF THE DRAWINGS heading, which begins on page 4, of the November 8th 2005 substitute specification, with the following Examiner amended grammatical correction paragraphs, with respect to Examiner amended New Figure 3.

reference numerals 1: a yoke; 2: magnetic material; 3: pole head; 4: plate for eliminating vortex, (i.e. eddy currents); 5: field-homogenizing ring; 6: gradient coil.

Fig. 3 is a perspective view of the yoke of the magnet of Figs. 1 and 2.

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E5) Replace the paragraph beginning on **page 4, In the second to last line** of the **November 8th 2005 substitute specification**, with the following **Examiner amended** grammatical correction paragraph:

As shown in **Figs. 1, 2 and 3**, the magnet of the present invention comprises a yoke 1, magnetic material 2, pole heads 3, plates for eliminating vortex 4, rings 5 for homogenizing magnetic field, and gradient coils 6. The yoke 1 has an integral, substantially C-shaped and opened structure with **two columns 7 and 8 separated by an opening 9**. The magnetic material 2 is adhesively bonded to the yoke 1, the pole heads 3 are adhesively bonded to the magnetic material 2 respectively, the plates for eliminating vortex 4 are adhesively bonded to the pole heads 3 respectively, the gradient coils 6 and rings 5 for homogenizing magnetic field are fixed to the pole heads 3 by screws, respectively.

F) Replace the abstract of September 29th 2004 with the following **Examiner Amended Abstract**

Abstract

The present invention discloses a permanent magnet for magnetic resonance, which is used for a magnetic resonance imaging apparatus for medical diagnosis. The permanent magnet of the present comprises permanent magnetic material; pole heads; plates for eliminating vortex (i.e. **eddy currents**); rings for **homogenizing the** magnetic field; gradient coils; and a yoke, said yoke of the permanent magnet has an integral and substantially C-shaped structure formed with two columns and is **an open type configuration**. This invention fully ensures the parallelism of the lower and upper poles, greatly improves the mechanical strength of the yoke, and results in a good magnetic uniformity and a **consistent** magnetic current.

Examiner's Amendment to the Drawings:

G) The following changes to the drawings have been approved by the examiner and agreed upon by applicant, as per the telephonic interview of January 19th 2005.

G1) Applicant will **amend figure 2 to indicate components 7, 8, and 9**, wherein component **7** is a **first column**, component **8** is a **second column** and component **9** is the **opening between first column 7, and second column 8**.

G2) Applicant will add a **new additional figure 3**, which is a **perspective view of the yoke of the magnet of Figs. 1 and 2**, and corresponds to the applicant's unofficial appended reference, for examiner use only that was confusingly listed as Fig. 4 of the November 8th 2005 amendment and response, but which was not an official figure in the application at the time of the filing of the November 8th 2005 amendment and response. The applicant has agreed to file this new figure because it allows a three-dimensional perspective of figures 1 and 2 combined, and shows the novel yoke configuration of the invention over the known prior art permanent magnet structures.

G3) Applicant's **new additional figure 3**, which is a **perspective view of the yoke of the magnet of Figs. 1 and 2**, will also show an identify component **7** a **first column**, component **8** a **second column** and component **9** the **opening between first column 7, and second column 8**. The **New official / additional figure 3** and the labeling of the **components 7, 8, and 9** is not new matter because these components are presented two-dimensionally in originally filed figure 2. The examiner has requested this amendment so that the applicant's novel permanent magnet structure can be clearly illustrated in applicant's figures via a three-dimensional perspective. In order to avoid abandonment of the application, applicant must make these above agreed upon drawing changes.

The following is an examiner's statement of **Reasons for Allowance**:

4. With respect to **Examiner Amended independent claim 6** and **Examiner amended dependent claims 7, 8, and 9** These claims are considered to be allowable over the **prior art of record** because the **prior art of record** does not disclose or suggest an MRI permanent magnet apparatus/structure comprising the limitations of “a

yoke, wherein said yoke of the permanent magnet has: an integral, substantially C-shaped and open structure formed with two columns, said yoke is integrally manufactured by casting, and wherein said yoke is annealed twice” in combination with each of the remaining structural limitations and features of each of the claims. It is the combination of all of the claim limitations taken as a whole, in combination with the novel and non-obvious permanent magnet yoke, as set forth above, that constitutes both the novelty and non-obviousness of applicant's claims.

5. It would not have been obvious to one of ordinary skill in the art at the time that the invention was made, to have a permanent magnet yoke of an MRI magnet being an integral, substantially C-shaped and open structure formed with two columns, where said yoke is integrally manufactured by casting, and wherein said yoke is annealed twice because conventionally using a yoke with a substantially C-shaped and open structure, implies the use of a single connecting column, in order to form a substantially “c”-shaped configuration. The use of two columns, in forming this structure with annealing being performed twice, is not readily suggested or apparent, by the structure claimed, because the presence of two columns is suggestive of an “H” or “a Block printed capital letter “I” (i.e. the letter “H” rotated 90 degrees). The ability to form a substantially “C” shaped open magnet structure with a two column yoke, as set forth by applicant teaches away from the **known MRI permanent magnet assemblies** with both a substantially “C” shaped and open magnet structure in the configuration, where said yoke is integrally manufactured by casting, and wherein said yoke is annealed twice.

6. Additionally the examiner notes that permanent magnet material is conventionally heavy, which is why known MRI permanent magnet configurations of the prior arts conventionally have a yoke formed from a single “C” or “I” shaped support, when an open magnet design is needed. Alternatively the prior art of record also teach and use two or more support posts, which are not integrally formed by casting, in open configurations. The ability to construct a permanent magnet configuration with a two column yoke, from separately connected components is known, but these separately connected components, of the prior art of record do not meet applicant's feature of the

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yoke being formed as an **integral formation by casting**. The improvement of applicant's permanent magnet is that the two column yoke of the permanent magnetic structure is integrally manufactured by casting, and the yoke is annealed twice. The examiner notes that an integrally formed (i.e. a single piece) yoke comprised of two columns twice annealed, being shaped so that the structure is open, and also substantially in the shape of a "C", combined with the other features of applicant's claims, was heretofore unknown for a permanent magnet structure in the art of MRI technology. Therefore the applicant's permanent magnet structure as entirely set forth in **examiner amended independent claim 6** is considered to be a novel and non-obvious configuration of an MRI magnetic field producing permanent magnet.

7. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Examiner's Comment
Priority

8. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Drawings

9. The drawings submitted November 8th 2005 are objected to because figures 3 and 4 of the November 8th 2005 response are not actual figures of the instant application they are simply explanatory figures for applicant's arguments in the November 8th 2005 response as to the structural differences between applicant's invention and the prior art. At the present time **only figures 1 and 2 are currently a part of the instant application.**

10. The examiner notes that applicant's unofficial appended figure 4 of the November 8th 2005 amendment ant response, is persuasive in perspectively showing the differences between the prior art and the instant application, however for applicant's arguments to be fully persuasive applicant needs to add unofficial appended figure 4 of the November 8th 2005 amendment ant response, to the actual application officially as

figure 3, with proper component labels, as set forth in the **examiner amendment to the drawings Section G** above.

11. A New set of corrected drawings are required in this application because the official draftsman has objected to the drawings submitted **11/08/2005 because** there are stray toner lines on these drawings.

12. A **complete set of NEW FORMAL DRAWINGS** including any and all examiner approved drawing changes, that have occurred during this examination **including the examiner approved amendments to the drawings listed above, (i.e. see section G of the examiner's amendment) and the inclusion of a new figure 3 which is not new matter because it simple shows what is illustrated in figures 2 and 3 in three dimensions**, are now required. [See the attached PTO 948 form of the Official Draftsman's Review.]

13. Applicant is advised to employ the services of a competent patent draftsman outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

Specification

14. The objections to the disclosure from the August 10th 2005 office action are rescinded in view of the **substitute specification submitted November 8th 2005**, (i.e. which has been marked okay for entry by the examiner) and the **examiner amendments** above which further amend the **substitute specification submitted November 8th 2005**. [See the **Examiner Amendments of E1 through E5**, and the examiner's amendment of the **abstract in Examiner's Amendment F** above.]

Prior Art of Record

15. The **prior art made of record** and not relied upon is considered pertinent to applicant's disclosure.

A) Bryne et al., US patent 6,211,676 B1 issued April 3rd 2001, filed March 11th 1997. [See figure 1, the reference teaches that the configuration may also be formed by permanent magnets.]

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- B) **Siebold et al.**, US patent 5,729,188 issued March 17th 1998.
- C) **Ohashi et al.**, US patent 5,864,275 issued January 26th 1999. [See figures 4a, 4b, 4c].
- D) **Ohashi et al.**, US patent 5,963,117 issued October 5th 1999. [See figures 4a, 4b, 4c].
- E) **Minkoff** US patent 5,623,241 issued April 22nd, 1997. [See figure 1.]
- F) **Huson et al.**, US patent 5,315,276 issued May 24th 1994. [See figures 1, 5].
- G) **Laskaris et al.**, US patent 6,150,819 issued November 21st 2000.
- H) **Laskaris et al.**, US patent 6,259,252 B1 issued July 10th 2001, filed November 24th 1998.
- I) ***Barber** US patent 6,150,818 issued November 21st 2000. [See figures 1 and 7]
- J) ***Damadian et al.**, US patent 6,335,623 B1 issued January 1st 2002, filed November 25th 1998.
- K) ***Damadian et al.**, US patent 6,023,165 issued February 8th 2000, filed December 18th 1992.
- L) **Schultz** US patent 5,818,901 issued October 6th 1998. [See figure 1].
- M) ***Cheng et al.**, US patent **6,842,002** A1 issued January 11th 2005, with an effective US priority prior art date of January 19th 2000. [Has only a 1-column yoke]
- N) ***Sellers** US patent 5,431,165 issued July 11th 1995.
- O) ***Cheng et al.**, US patent application publication **2003/0001575** A1 published January 2nd 2003, with an effective US priority prior art date of January 19th 2000. [Has only a 1-column yoke]
- P) ***Cheng et al.**, international publication **WO 01/53847** A1 published July 26th 2001, with an effective US priority prior art date of January 19th 2000. [Has only a 1-column yoke]

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Conclusion

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

17. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez, can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(571) 273-8300**.



TAF
January 23, 2006



Diego Gutierrez
Supervisory Patent Examiner
Technology Center 2800

Please Enter
Ex. TAP 1-23-05

Appl. No. 10/509,573
Amdt. Dated January 19, 2006
Reply to Office Action of August 10, 2005
REPLACEMENT SHEET

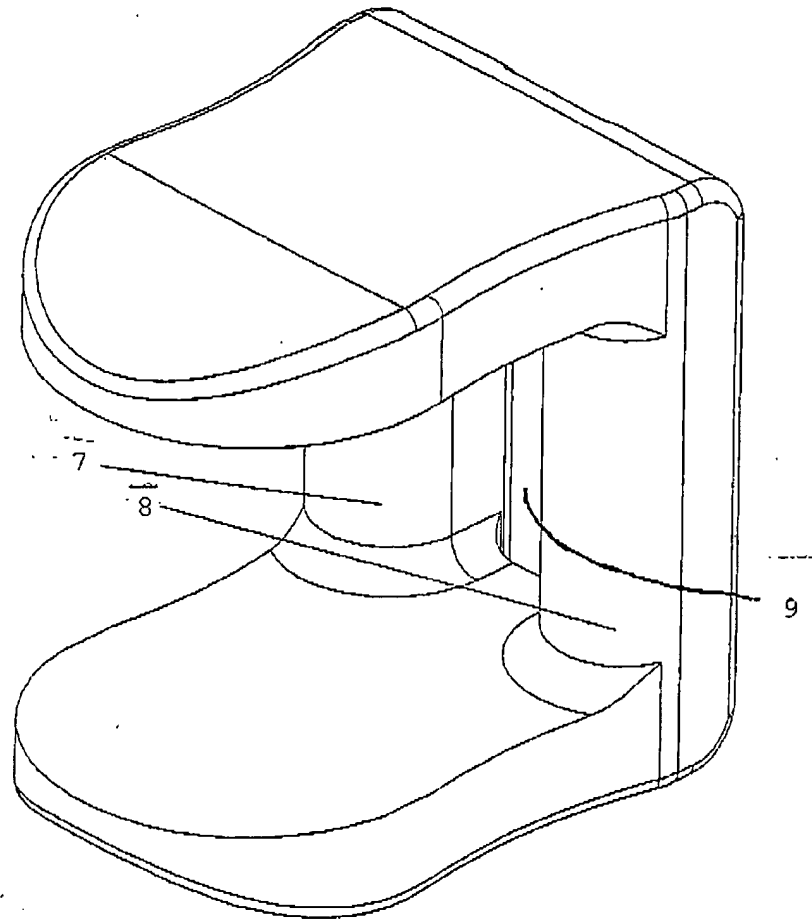


Fig. 3